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(71) Applicant(s)
Northern Telecom Limited

(Incorporated in Canada - Quebec)

**World Trade Center Of Montreal,
380 St Antoine Street West, 8th Floor, Montreal,
Quebec H2Y 3Y4, Canada**

(72) Inventor(s)
Peter John Chrystie
Gerard Marque-Pucheu
Clement Frederick Fisher

(74) Agent and/or Address for Service
G M C Kent
**Northern Telecom Europe Limited,
Patents and Licensing, West Road, HARLOW, Essex,
CM20 2SH, United Kingdom**

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(56) Documents Cited
GB 2006579 A **US 4941199 A**

(58) Field of Search
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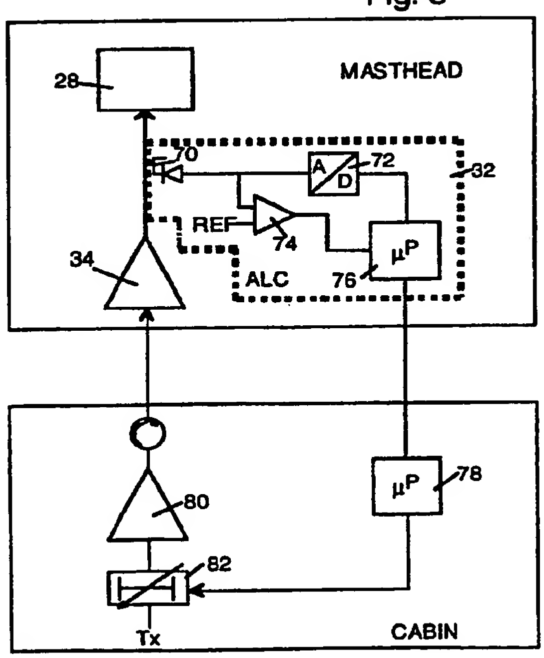
INT CL^5 **H04B 7/005 , H04Q 7/04**
ONLINE : WPI

(54) **Base station transmitter control**

(57) A cellular radio base station arrangement has a plurality of r.f. transceivers TX each for transmitting and receiving r.f. signals to and from antenna arrays 28 via respective transmit and receive feed means for one or more calls. The arrangement includes means 32 for monitoring the effective isotropic radiated power (EIRP) at the antennas. A communication link transfers the detected antenna transmit power levels to the r.f. transceivers where adjustment means 82 vary the power levels fed to the antennas to maintain the EIRP within maximum permitted levels.

Fig. 3



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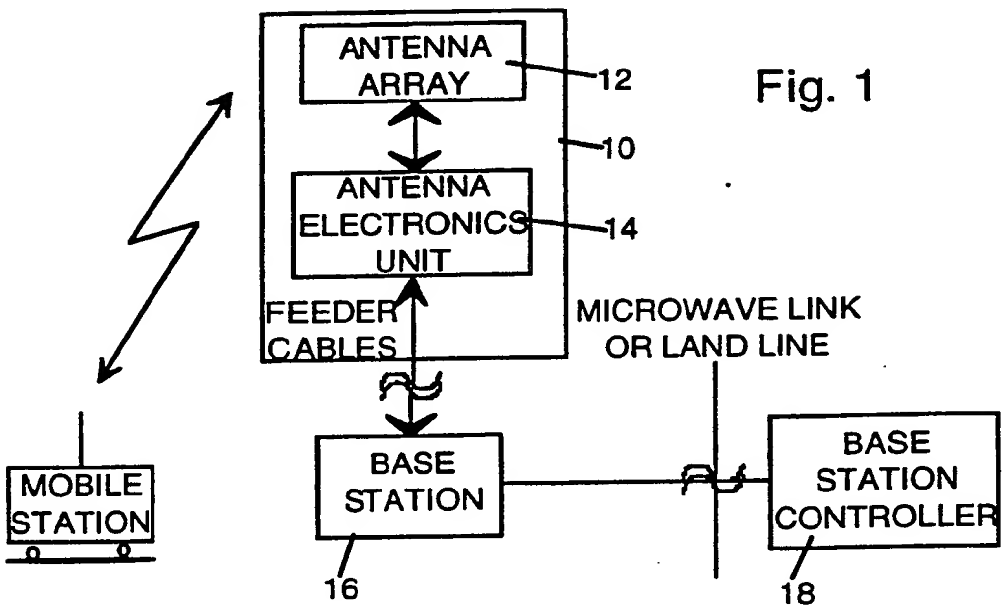
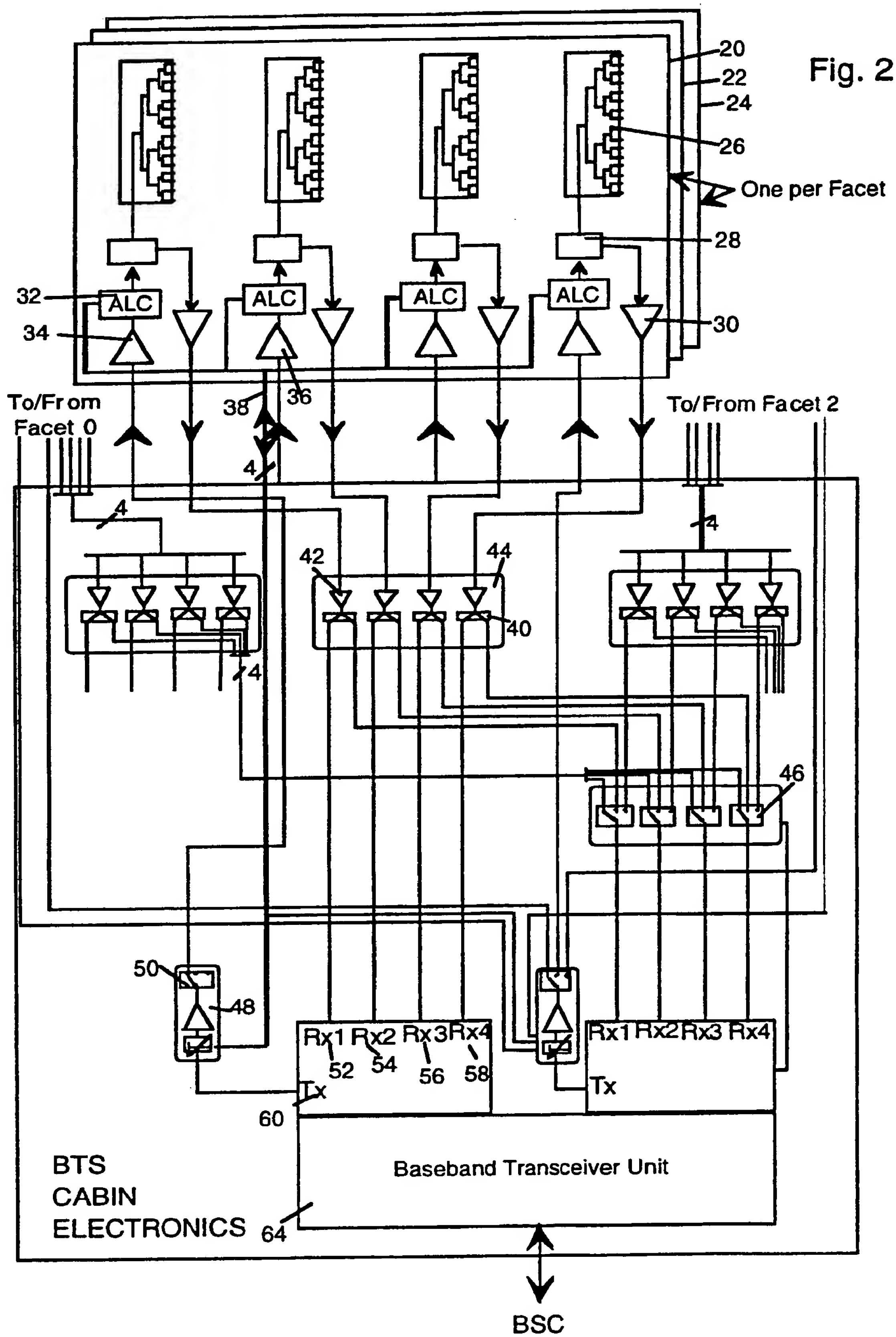

ANTENNA ARRAY
12
10
ANTENNA ELECTRONICS UNIT
14
FEEDER CABLES
MICROWAVE LINK OR LAND LINE
MOBILE STATION
BASE STATION
16
BASE STATION CONTROLLER
18

Fig. 1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One per Facet
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To/From Facet 2
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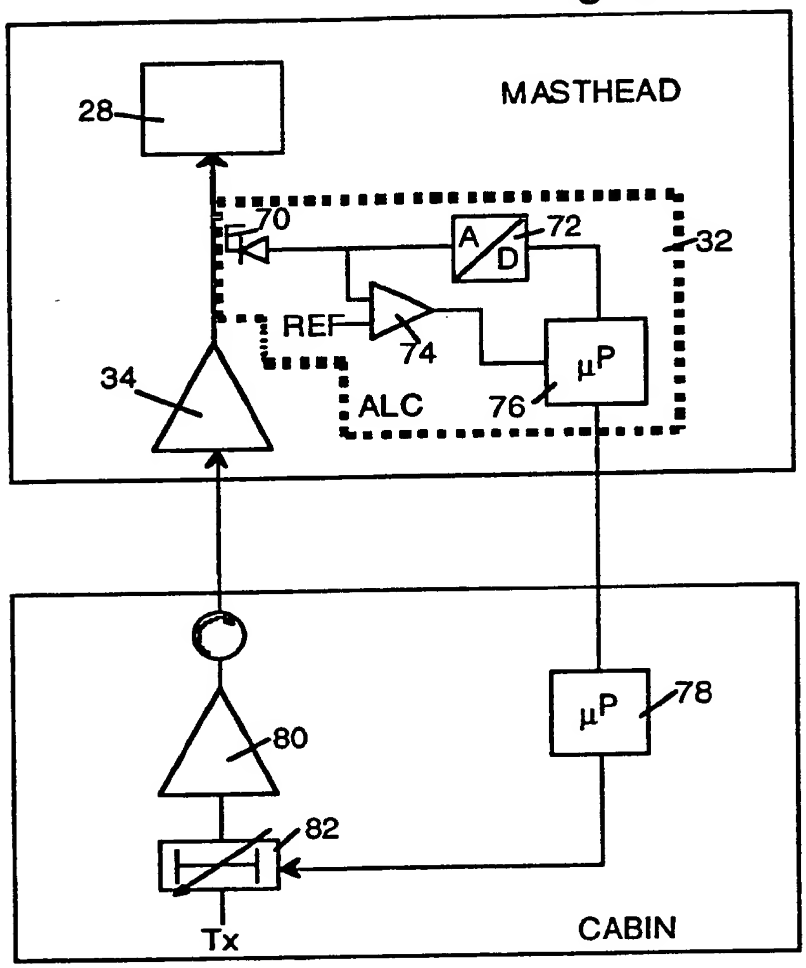
4
46
50
48
Rx1 Rx2 Rx3 Rx4
52
54
56
58
Tx
60
Rx1 Rx2 Rx3 Rx4
Tx
Baseband Transceiver Unit
BTS CABIN ELECTRONICS
64
BSC

Fig. 2

Fig. 3



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Base Station Arrangement

This invention relates to a base station arrangement, for use in a cellular radio communications system.

Cellular radio systems are currently in widespread use throughout the world providing telecommunications to mobile users. In order to meet the capacity demand, within the available frequency band allocation, cellular radio systems divide a geographic area to be covered into cells. At the centre of each cell is a base station through which the mobile stations communicate with each other and with a fixed (wired) network. The available communication channels are divided between the cells such that the same group of channels are reused by certain cells. The distance between the reused cells is planned such that co-channel interference is maintained at a tolerable level.

When a new cellular radio system is initially deployed operators are often interested in maximising the uplink (mobile station to base station) and downlink (base station to mobile station) range. Any increase in range means that less cells are required to cover a given geographic area, hence reducing the number of base stations and associated infrastructure costs. The downlink range is primarily increased by increasing the radiated power from the base station.. National regulations, which vary from country to country, set a maximum limit on the amount of effective isotropic radiated power (EIRP) which may be emitted from a particular type of antenna being used for a particular application. In Great Britain, for example, the EIRP limit for digital cellular systems is currently set at +56dBm. Hence the operator is constrained and, in order to gain the maximum range allowable, must operate as close as possible to the EIRP limit, without exceeding it.

Sectored cells with multiple (usually 3 or 6) directional antennas are used as a means of extending the range whilst maintaining a balanced

link. The higher gain of the narrower beamwidth antennas improves the uplink from the lower power mobiles, as well as the downlink.

Standard sectored systems, with transceivers allocated solely on a per sector basis, incur a significant level of trunking inefficiency in low capacity environments where there is an occasional requirement for more than one transceiver. In order to avoid excessive blocking a tri-sectored system with fixed sector transceivers has to use more transceivers than would be required by an omni antenna for the same traffic capacity.

Systems using a combination of fixed and floating transmitters have been recognised as prior art, see for example, the general principle of dynamic allocation as described in US 4,144,496 by Cunningham et. al. and for a specific arrangement of a combined system as given in EP 0 359 535 A3 by Smith et. al.

The present invention is an architecture employing a combination of fixed and floating transceivers, the latter of which can be allocated on a timeslot by timeslot basis.

According to the present invention there is provided a cellular radio base station arrangement comprising a plurality of r.f. transceivers each for transmitting and receiving r.f. signals to and from an antenna via respective transmit and receive feed means for one or more calls, the arrangement including one or more antenna arrays wherein each array comprises individual transmit amplifying means for each simultaneous call, the amplifying means being coupled to the antenna via level sensing means, communication means for transferring the detected level to the r.f. transceiver, and adjustment means to vary the power level fed to the antenna.

In one embodiment of the invention wherein said antennas comprise a plurality of directional antennas, with each directional antenna being allocated permanently to one of a number of sectors, some of the plurality of r.f. transceivers are each permanently coupled to a particular respective antenna and the remaining r.f. transceivers are coupled to

switching means to allow one or more of the remaining r.f. transceivers to be allocated temporarily to any of said antennas.

Embodiments of the invention will now be described with reference to the accompanying drawings, in which:-

Fig. 1 is a block diagram of the main elements of a base station,
Fig. 2 is a diagram of the constituents of a floating transceiver, maximum EIRP base station
Fig. 3 is a detailed diagram of the constituents of the EIRP automatic level control circuitry.

The main elements of a base station as shown in Fig. 1 include a so-called 'smart antenna' comprising a mast, tower or building 10 supporting the antenna array(s) 12 and associated antenna electronics unit 14, which includes beamformers, diplexers and amplifiers. The antenna electronics unit 14 is connected to the base station 16 that is under the control of a base station controller 18 which may be located remotely from the base station.

The detailed constituents of the smart antenna are shown in Fig. 2. The antenna shown is of the type previously disclosed in the applicant's co-pending application 9402942.8. For clarity only one of the three antenna arrays 20, 22 and 24 and two of the r.f. transceivers, one 'fixed' transceiver 60 and one 'floating' transceiver 61, are depicted. Each antenna array 20, 22, 24 comprises multiple sub-arrays 26 with each sub-array comprising a conventional column of individual antenna elements.

The transmit and receive signals for each sub-array are coupled to the sub-array via diplexers 28. Filters that cover just the transmit or receive frequency bands respectively can be used for this purpose. In the transmit path the diplexers 28 are fed, via an automatic level control (ALC) circuit 32, from single carrier power amplifiers 34. These amplify the r.f. signals up to the power levels required for transmission.

The automatic level control circuit for a single transmit path is shown in greater detail in Fig. 3. The ALC circuit 32 as shown comprises a power sensing element 70 that feeds an analogue-to-digital (A/D) converter 72 and a comparator 74. The comparator is used to detect the presence of a signal during a timeslot and is used to trigger a sequence of events within the microprocessor 76. The microprocessor accepts a reading from the A/D converter and in the following timeslot transmits this data down a serial link to an associated microprocessor 78 in the cabin. The cabin microprocessor 78 in turn controls a variable attenuator 82 that has a range sufficient to cope with expected variations in mast height together with fluctuations due to temperature, loading, etc. In the transmit path the signal is fed from the transmitter 60 via the attenuator 82, through a pre-amplifier 80 and then through one path of a 3 way switch 50, prior to reaching the masthead where it is amplified to its final level by the single carrier power amplifier 34.

Referring again to Fig. 2, in the receive path the diplexers 28 feed separate substantially identical low noise amplifiers 30. The low noise amplifiers are required to amplify the weak received r.f. signals prior to any system losses to establish a low noise figure (high sensitivity) in the subsequent receive path. Signals are passed from the low noise amplifiers 30 through pre-amplifiers 42 to receive splitters 40. These are n-way splitters where n depends upon the number of fixed and floating transceivers allocated to a sector. One path from each receive splitter 40 in a receive splitter module 44 is connected to one of the receive input ports 52, 54, 56, 58 of the multiple diverse receiver. This connection will be direct for fixed transceivers or via a 3-way switch 46 (one for each facet or sector) for floating transceivers.

The key features of the invention can now be considered in more detail and contrasted with the conventional sectorised base station. The positioning of an EIRP power sensor prior to the diplexer in the antenna allows the radiated power to be monitored. The level is digitised before being sent to the relevant transceiver. The output level from the BTS cabin can then be adjusted to enable a constant maximum power level to be radiated from the antenna. Monitoring the power at the masthead allows the level to be set independently of installation site configurations

such as mast height and cable length. It also means that the system can tolerate fluctuations due to temperature, loading, component tolerances, etc. without losing peak output power.

The use of floating transceivers to be shared between sectors in conventional base stations requires the use of high power switches with the attendant problems of isolation, power loss, intermodulation products, etc. The positioning of the switches in this invention prior to the main amplification and prior to the level detection allows low power switches to be used and the inherent power loss associated with the switches to be compensated for.

CLAIMS

1. A cellular radio base station arrangement compriseing a plurality of r.f. transceivers each for transmitting and receiving r.f. signals to and from antenna arrays via respective transmit and receive feed means for one or more calls, the arrangement including means for monitoring the EIRP at the antennas, means for transferring the detected antenna transmit power levels to the r.f. transceivers, and means at the transceivers for adjustment of the power levels fed to the antennas to maintain the EIRP within maximum permitted levels.

2. A cellular radio base station arrangement according to claim 1 wherein said antennas arrays each comprise a plurality of directional antennas, with each directional antenna being allocated permanently to one of a number of sectors, some of the plurality of r.f. transceivers each having its transmitter output permanently coupled to a particular respective directional antenna and the transmitter outputs of the remaining r.f. transceivers being coupled to switching means to allow one or more of the remaining r.f. transceivers transmitter outputs to be allocated temporarily to any of said directional antennas.

3. An arrangement according to claim 2 wherein each antenna feed means includes a transmit power amplifier, said switching means being incorporated in the antenna feed means between the r.f. transceivers and the power amplifiers.

4. A cellular radio base station arrangement substantially as described with reference to the accompanying drawings.

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Patents Act 1977 **Examiner's report to the Comptroller under Section 17** **(The Search report)**	Application number GB 9410809.9
Relevant Technical Fields (i) UK Cl (Ed.M) H4L (LETXX, LDLX); H4K (KY4D10, 10R, 10T); H3Q (QPXX) (ii) Int Cl (Ed.5) H04B 7/005; H04Q 7/04	Search Examiner N W HALL Date of completion of Search 15 AUGUST 1994
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ON-LINE: WPI	Documents considered relevant following a search in respect of Claims :- 1 TO 4

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
Y	GB 2006579 A	(NIPPON TELEGRAPH) whole document	1, 2
Y	US 4941199	(SAAM) whole document	

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

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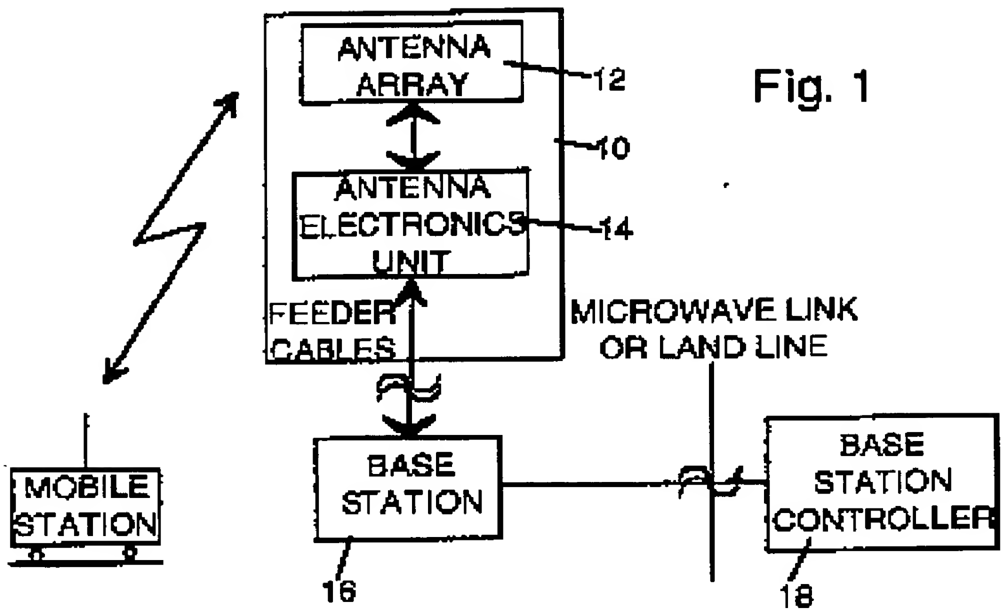
ANTENNA ARRAY
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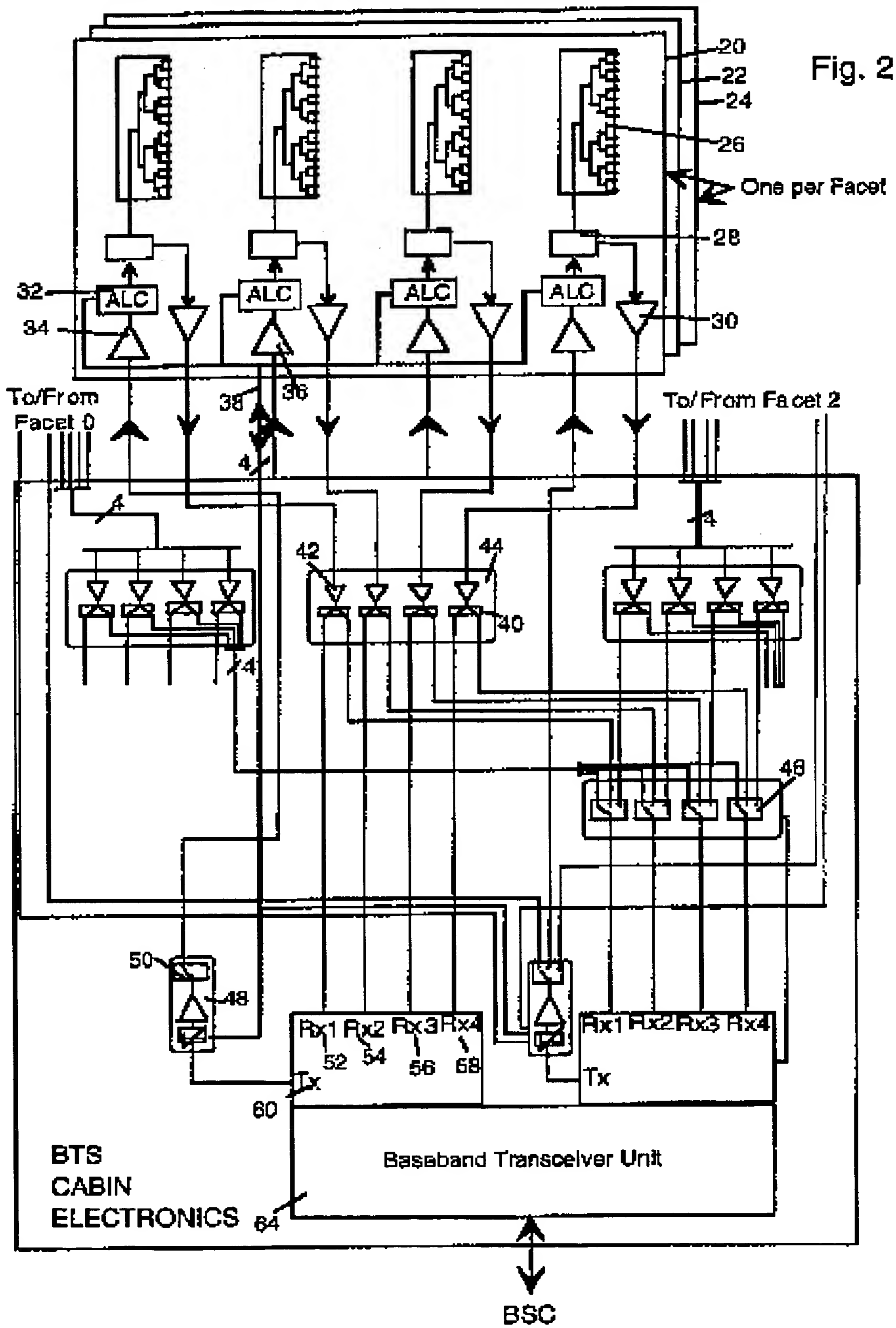
ANTENNA ELECTRONICS UNIT
14
FEEDER CABLES
MICROWAVE LINK OR LAND LINE
MOBILE STATION
BASE STATION
16
BASE STATION CONTROLLER
18

Fig. 1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Rx1 Rx2 Rx3 Rx4
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Tx
60
Rx1 Rx2 Rx3 Rx4
Tx
Baseband Transceiver Unit
BTS
CABIN
ELECTRONICS
64
BSC

Fig. 2

Fig. 3